

The I24 Microfocus MAD beamline at Diamond Light Source.

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In light of challenges raised by crystallography of large multi-protein complexes and membrane proteins, in the form of very small, relatively disordered and weakly diffracting crystals, Diamond Light Source set out to design and construct a versatile beamline system capable of adapting X-ray beam characteristics, crystal by crystal, in order to enhance signal to noise in diffraction data and increase likelihood of structure determination.

The resulting instrument, the I24 microfocus MAD beamline [1], has been operational since late 2008 and is already generating significant results in structural biology. During design and construction effort was focused on spatial stability of the beam over a large frequency range while maintaining a high level of versatility. With versatility came complexity, thereby generating the challenge of usability for inexperienced users and crystallographers. The beamline offers a energy range of 6-25 keV and a beam size of $<5\mu\text{m}$ to $>100\mu\text{m}$ with a variable focal length away from the sample of up to $\sim 500\text{mm}$. The unique two stage demagnification design and movable microfocusing mirrors provide for a partial decoupling of beam size at sample and focal length thereby allowing optimization of beam parameters to match both crystal and detector characteristics.

Adjacent to the beamline is the Wellcome Trust funded Membrane Protein Laboratory [2]. The proximity of the two facilities serves as a proof of principle for accelerating the crystal characterization and optimization stages so critical to successful membrane protein structure determination. Combined developments between the facilities are addressing the challenges of routine in-plate crystal screening.

The presentation will discuss how the design challenges were addressed and what measures are being taken to ensure that the beamline retains a high level of feature accessibility for its users. Results of commissioning and users experiments will be presented.

[1] <http://www.diamond.ac.uk/Home/Beamlines/MX/I24.html>

[2] <http://www.diamond.ac.uk/Home/MPL>